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Skills and motivation in ad-hoc-collaboration

Dirk Frohberg[1] and Gerhard Schwabe

[1] University of Zurich
frohberg@ifi.unizh.ch

[2] University of Zurich
schwabe@ifi.unizh.ch

Abstract

Mobile technologies offer the opportunity to collaborate spontaneously any time and any place. While researchers have begun to understand the skills and motivational consequences of distributed office meetings, we are only beginning to understand them for ad-hoc collaboration. This paper reports on an analysis of two exploratory experiments dating from 2004 and 2005. Ad-hoc collaboration requires specific skills for process facilitation, communication, planning, media usage, multi-tasking, as well as specific social skills. Those skills need to be different in their characteristic than those skills necessary for traditional face-to-face and distributed meetings. A fast action and reaction cycle leads to raised excitement and motivation despite the difficulties the group has in organizing their work.

1 Introduction

When a Nokia customer service agent travels to visit a new customer, he can use their SMS community to ask fellow customer service agents how to deal with the new customer. Typically, they can access important customer data as well as gather input on how to sell to the customer[1]. This SMS community is widely accepted because it allows customer service agents to exchange ideas, sometimes required on an ad hoc basis, over a familiar medium. This approach symbolises a radical change in providing support for collaboration. Prior approaches bound collaboration to given technological settings such as meeting rooms or workplaces. Mobile technology provides support when the need arises. The support relies less on systematic analysis of data than on creative and informal ad-hoc input. This is an opportunity but also a challenge to the designers of mobile systems: “Last, but not least, we believe that the successful adoption of these [mobile[2]] solutions will depend on their capability to act as connecting tools: connecting people, ideas, and contexts. This capability of connecting also

[1] Interview with Riitta Vänskä (Nokia representative) during a regular MOBIlearn meeting in 2004.

[2] Addition by the author

requires a switch from short term to long term creative thinking, with a better integration of the creative process into everyday life" [Shibata and Hori 2002].

An increase in mobile collaboration may also reduce well known difficulties in localising and organising people for face-to-face meetings. [Lundin&Magnusson 2003, Bellotti & Bly, 1996; Nardi & Whittaker, 2002] These difficulties are a major obstacle for the opportunistic meetings required by unplanned creativity, unexpected problems, opportunities and incidents [Whittaker et al., 1994].

When people most need creative input from others, they are unable to make contact with sufficient speed. The diffusion of mobile technologies has opened communication channels allowing to share ideas whenever and wherever they appear. We are currently moving to a situation where it is more likely that a person has a mobile phone available than a pen and paper. Thus, mobile phones may be an ideal device to support creativity and informal collaboration.

The triumphal procession of mobile phones during the recent years has already significantly changed the coordination and planning behaviour towards informal 'lazy planning' in every day's life, especially among youngsters: They just agree roughly after school to undertake something in the evening and trust for detailed and spontaneous coordination on the modern communication media as messenger, mail, but particularly their mobile phone and SMS [Sacher et al., 2002]. Thus mobile technology raises the individual degree of freedom. After mobile communication and mobile coordination, the next step on the ladder of complexity would be mobile collaboration. Mobile collaboration integrates communication and coordination, but adds the shared work with material, i.e. the processing of information to formal output. The challenge in mobile ad-hoc collaboration is its unstructured process. We found in our experiments that people are nowadays quite unable to deal properly with the low formality of mobile collaboration. They do not naturally have the necessary skills to collaborate without a clearly designated moderator and when lacking a thoroughly prepared process. This incapability was known from common collaboration in large groups, while smaller groups have a good intuition for informal collaboration. But in mobile settings even small groups fail to collaborate effectively. Just like the capability of lazy planning has evolved in mobile coordination, mobile collaboration will only be successful, if an appropriate set of skills is developed and spread. What is this skill-set and how is it different from the skill-set of established collaboration? As there is surprisingly little knowledge about this, we ran a series of exploratory experiments studying the developing skill-sets of successful participants. Astonishingly, mobile collaboration does not only pose particular challenges on the participants, but also has a motivational effect on them. We therefore decided to include this motivational effect in our study.

In the following chapter 2, we will first define and characterise the nature of ad-hoc-tasks and discuss prior research on skills for distributed and ad-hoc-collaboration. Chapter 3 will report on the research approach and the data collection in experiments. In chapter 4 we present the most interesting preliminary findings from the first series of experiments. Chapter 5 will summarize the lessons learned.

2 Literature and research questions

2.1 Ad-hoc-collaboration collaboration

Research in the area of computer supported collaboration of distributed groups aims towards bridging distribution in time and space as efficiently as possible. Systems usually trust on prepared locations with powerful desktop computers. CSCW researchers have expended a considerable amount of effort trying to emulate physical collocation using advanced techniques in audio and video communication (e.g. [Ishii& Kobayashi 1992]), sharing document repositories [Bentley et al. 1997] and creating a sense of awareness of the activities of the others [Prinz 2001]. Newer research on collaboration detected mobile technology to shift the limitation of space further and support groups with members being mobile. Systems like Placememo, SoundPrayer [Esbjörnsson et al., 2002], MenuMe, CallKiosk, or Netman [Chang, 2003] allow people to deliver material or information into a database, that can be searched and used, by other people. Such systems basically work as market to match offer and demand. Other systems like Hocman [Esbjörnsson et al., 2002], IPAD, Hummingbird, ProxyLady, AIDA [Wang et al., 2005], Smart-Its YCab, MagicLounge [Chang, 2003], or ActiveCampus [Griswold et al., 2004] heavily support mobile communication and awareness, which are basic prerequisites for mobile collaboration. A whole strand of research about computer-supported collaboration serves loosely coupled groups to cooperate in an opportunistic way and is excellently covered in a doctoral thesis of Pinelle [2004]. All systems have in common to interpret distributed locations as obstacle and restriction, which must be overcome. Furthermore all systems provide a clear idea how the group members are supposed to act in order to ensure maximum efficiency.

This paper introduces mobile, spontaneous, collaborative tasks (called 'ad-hoc-tasks') being different in two aspects. Firstly distribution is not seen as obstacle, but purposely established as challenge. Secondly the proposed setting is not suggesting an optimal process to the group but challenges the group to find the optimal process on their own. Acting in highly informal, dynamic and complex collaborative situations drives the group to their limits of collaboration abilities.

We are defining the following characteristics for an ad-hoc task.

1. The point in time the task is given is unknown and unpredictable
2. The task is unknown beforehand
3. There is no socialised standard procedure how to deal with the concrete task
4. The task has a 'high enough' priority not to be ignored
5. The available time to solve the task is 'critical enough' not to be shifted until conditions for collaboration have improved
6. The task requires to be solved collaboratively. The need for collaboration can be manifold:
   - The necessary information to solve the task is spread among several people
   - The task is too complex and resource taking to be solved by one or two persons
   - The task requires people to contribute from dedicated locations

- The addressees of the task are equal in rank and have different interests. Individual decisions without group consultation will not be accepted.

- The task is ambiguous and needs the creative power of many brains

Here are some examples for ad-hoc tasks as they may occur in business or private life:

- A proposal for a huge bidding must be sent and the deadline is close. The team heard of it in the very last minute.

- The client asks very urgently for a status report of the project. He comes over for a visit in the afternoon and asks for a 30 minute presentation.

- Some friends decide to meet in the evening, have dinner together and watch a video. They want to coordinate who brings which dishes and what film to get from the video store.

- In case of a disaster (e.g. flooding), the endangered people need to collaborate and coordinate activities until and beyond professional units can take responsibility.

2.2 Skills for successful distributed and ad-hoc collaboration

Most humans have acquired first basis skills and competencies for collaborating in small, face-to-face groups through their socialisation in their family. The acquisition continues throughout school, secondary education and business life, as face-to-face small group collaboration is widely used there. This socialising begins early and happens so intensively that the acquired behaviour appears “natural” and “intuitive” to most humans. Unfortunately, this set of behaviours does not scale to larger groups, as larger groups have different problems than smaller groups (e.g. sharing airtime or different group dynamics) [Schwabe 2004, Nunamaker et al. 1991, Löber et al. 2006]. Research on Group Support Systems recommends using a skilled facilitator to design and manage the group collaboration process [Schwabe 1995]. Similarly, the “naturally” acquired skills may not be applicable to distributed groups[3]. An analysis of best practice for distributed collaboration by McQuaid et al. [2000] leads to the following particular skills:

- process facilitation skills: enhanced process control, especially in convergent phases
- planning skills: more explicit pre-planning
- communication skills: explicit communication of status information, e.g. progress, reduce ambiguity of target and source of communication by making the source explicit, organize channel choice
- social skills: Organize social breaks (which are obvious in co-located meetings)
- awareness skills: create a feeling of co-presence; remind participants of co-presence.

These skills were deduced from running formal, pre-planned Group Support Systems meetings. Some are by definition not easily applicable to distributed ad-hoc-collaboration (e.g. planning skills). Furthermore the additional benefits (e.g. the possibility for immediate situated action [Schwabe et al. 2004, Luff&Heath 1998]) and

[3] The only exception is 1:1 collaboration over the telephone, which is currently widely practiced today.

challenges of mobile ad-hoc-collaboration (e.g. time pressure) are not covered by the prior literature. Thus, we were interested to find out what skills lead to successful ad-hoc collaboration. resulting in research question 1.

Research question 1: What are the particular skills required for participating in successful ad-hoc-collaboration?

While the skill set of a facilitator responsible for running the mobile collaboration is discussed in another publication [Schwabe&Frohberg 2006], this paper focuses on the skills of ad-hoc collaboration that typically do not have a predetermined facilitator available.

A particular challenge of distributed collaboration is the motivation of the participants. Many of the challenges reported by McQuaid et al. [2000] deal with motivational problems: Tasks may be postponed as they easily can be moved out of sight. It is easier for free riders to hide and distributed meetings lack "natural" mechanisms of feedback on open issues and successful task completion. Again, those challenges may not be as relevant to ad-hoc-tasks. Time pressure and tight, frequent interaction may add to motivation as well as the enhanced freedom of mobile participants. The contribution of mobility may be ambiguous: "Interestingly, users of mobile devices experienced a simultaneous sense of freedom from being bound to their desks with a tethered device, yet, at the same time, a sense of captivity owing to the compulsiveness of responding to communication initiated by others at any or every time." [Sarker&Wells 2003]. Thus, we took a special look at how ad-hoc-collaboration raises motivation, which is leading to research question 2.

Research question 2: What are the motivational effects of ad-hoc-collaboration?

3 Research approach and data collection

The idea of a mobile ad-hoc-task was born during the last phase of the EU-project MOBIlearn[4]. We are reporting on two experiments within MOBIlearn with ad-hoc-tasks in November 2004 and February 2005. A third series of experiments is currently running. Originally the whole setting was only thought to demonstrate and evaluate the readiness of the MOBIlearn system, which was aimed at supporting mobile cooperation. There we learned how overstrained even skilful people are when being confronted with mobile informal cooperation. So we decided to derive skills required for ad-hoc-collaboration both from successful and unsuccessful user behaviour. As research on ad-hoc-collaboration is still in its infancy, we chose an exploratory approach, striving for a deep understanding rather than for statistical significance. As there are no natural groups available for study, we designed a set of experiments which emulates natural group behaviour as closely as possible. A particular challenge was the design of the ad-hoc-task. As in the current stage the design of an appropriate experimental task is a contribution of its own, we will describe them in more detail.

The basic idea of an ad-hoc-task is as follows: "A small team is aware of the fact that they will be confronted with a suddenly appearing task which must be accomplished under high time pressure. The countdown to hand in the result is only about 4-6 hours after sending out the trigger. The task will surprise the team starting at any time during

[4] "MOBIlearn is a worldwide European-led research and development project exploring context-sensitive approaches to informal, problem-based and workplace learning by using key advances in mobile technologies." (http://www.mobilearn.org)

a given week. By the starting time the team members will most probably be busy with other tasks and have not scheduled this extra task. The group must organize itself on the fly and integrate the task in the context and activities that are currently running. These circumstances create a realistic and authentic ground for mobile collaboration." [Taylor et al., 2005]

3.1 Experiment 1: Ad-Hoc-Task as part of a formal exercise

The first experiment was part of a collaborative homework being integrated in a course about computer supported collaborative work (CSCW). Thus the participating students can be seen as semi-experts for collaboration. The course itself was a cooperation between University of Zurich (Switzerland) and University of Konstanz (Germany) with 24 students from Zurich and 10 from Konstanz. The ad-hoc-task was a voluntary and additional task awarded with some pocket money for each successful participant and cinema tickets for the best performing team. The purpose was to have the students experience very intensely the challenges of collaboration in mobile settings. The 34 participating students were distributed in ten teams. Each team except one had at least one member from Konstanz. All teams were given a trigger to run the task but could reject participation without consequences. 13 of 34 students (four of ten teams) decided to participate actively. The other teams signalised as well interest in participation and rejected for reasons like illness, important other obligations or non-availability of some group member. One exceptional and hindering factor was a low private accoutrement of computers by the students from Konstanz who were mostly exchange students. Accounting the general resistance for extra work among students, the high percentage of more than one third of voluntary participation is amazing and an indication for the attractiveness of such an ad-hoc-task. We will further analyse the factors of attractiveness in chapter 4.2.

Each team had some established technical setting of devices (exceptions mentioned above) and collaborative software. The software consisted of a defined bundle of synchronous and asynchronous tools for communication, coordination, and collaboration. It was in particular Skype, SmartIdeas, Netmeeting, Groove, ICQ, BSCW, and K3. At that time we were not aware of any useful, free and available mobile software, so the mobile support for the ad-hoc-task was basically limited to a mobile phone with SMS and laptops with wLAN-card, to be used within the wLAN-network at the University of Zurich. The teams were not provided with specific training how to deal with mobile ad-hoc-tasks.

Because moderation was complex each team got its own ad-hoc-task at an individual time. To avoid one team learning from another about the task, the experimenter provided individual tasks, but with similar components to ensure an equal level of complexity. The ad-hoc-task was tightly related to the obligatory homework featuring "collaboration between two universities", which each team had to work on simultaneously. When the ad-hoc-task started, the experimenter sent a mail with process-related information and an SMS, saying "Ad-hoc-task starts now for you. Check your mail". In the mail each team member found the information that he needs to phone the experimenter in order to get a piece of information about the task. Only the composition of all pieces of information would allow the team to solve the task completely. This had two reasons One was to simulate the situation of distributed non-written information among team members. The second reason was the experimenter

would keep control and be able to monitor, if the team would overcome the first hurdles.

Below there is exemplary one of the ad-hoc-tasks, split in the three pieces of information as the participants got it via phone. The tasks for the others were very similar in structure and complexity: "1: The university's television unit offers you to make a 4-minute film clip about the collaboration project between the universities of Zurich and Konstanz. But they need in advance a concrete multimedia story board with pictures and text to plan the film clip. 2: There must be the same number of pictures in the story board from both universities. Your two professors need to be interviewed in the film. Prepare an interview text. Search for some music to underlay the story board with it. Estimate the resources needed to make the film (time for camera man, people needed, time to machine finishing etc.). 3: Use Powerpoint. One slide represents 10 seconds of film time. Give explanations in the annotation frame,of the content of each slide. The background music can be in any format or quality. Record the original interview or (if not possible) put yourself in the role of the professors". The students had about 6 hours time to solve the task.

For observation and evaluation purposes, the team members were asked to fill a structured diary form (see figure 1), keeping notes for each single activity. This helped the experimenter to get a full picture of what happened in each group. The participants were asked to fill in a short questionnaire which contained questions about the technical and didactical setting which are of lower relevance for the paper at hand.

When? Time/ Dura-tion	**What? Activity**	**With whom? Partner**	**Why? Purpose**	**How? Medium or tool**	**With what? Device**	**With what? Mean**	**Where exactly? Own location**	**Context**	**Remarks (Technical problems, argument in the group, misunderstandings etc.)**
10.00 (CET)	Received SMS from Dirk for start of trial	Dirk	passive event	SMS	mobile phone	NokiaONE	cafeteria	eating breakfast with collea-ques	A nice conversation with my colleaques was interrupted :-(

Figure 1: Diary form with exemplary entry

3.2 Experiment 2: The MOBIlearn Ad-Hoc-Task Experiment

In the second experiment there were 12+1[5] volunteers from ten MOBIlearn partners spread over 6 countries. The whole experiment consisted of three tasks with increasing complexity. The general design of the experiment and the nature of the tasks were similar to those from the first experiment. In difference to the students from the first experiment, the employees of MOBIlearn partners were much better equipped with standard and mobile technology. All participants must be seen as experts in the domain of mobile learning and mobile technology. All participants were already under heavy workload and none could have blamed them for not participating. Obviously the announcement and idea of an ad-hoc-task sounds attractive to people.

[5] One participant was unavailable during the first two tasks.

The participants possessed and used their private devices (PDAs, laptops etc.) and some got a sponsored mobile phone. Additionally two software systems were given as support. One was sponsored by Nokia and supported synchronous, asynchronous and scheduled group-SMS with web access. The other one was the web-based mobile learning system from MOBIlearn with tools like an agenda, brainstorming, voting, messaging, chat, forum and the like. Data for evaluation has been captured in various forms as direct monitoring, logfiles, questionnaire, diary from participants and sporadic, informal discussions with individual participants. The core findings of this paper are based on the second experiment.

After technical tests with the MOBIlearn system, a training session via phone-conference had been organised to explain how to use the system. All other administrative and organisational issues during preparation had been managed via mail. Many thoughts had been put in how to compose the teams. In each team of three members there was at least one participant with some technical background to help the team members. Furthermore all team members came from different partner organisations to avoid simplification of solving a task. Two teams were consciously built with members from the core of MOBIlearn who knew and liked each other. In the third team people knew each other not very well. The people in the fourth team did not know each other at all. The first three teams were given an identity by finding a common attribute for all team members. There was the girls-team, the university-team, and the industry-team. The fourth team was purposely not given any identification. All teams were told to be in competition with the other teams collecting points for good performance. The winning team members would each get a mobile phone as reward The teams were free to use any device or software they liked to solve tasks, but extra points would be given to those who would use mobile devices and the suggested systems.

During the experiments the participants were confronted with the phenomenon of 'creeping commitment'. The tasks became by far more labour-intensive for all than promised and originally thought. This phenomenon was not planned but happened, because we underestimated by far the effort an ad-hoc-task would demand from participants.

The first task sounded as simple as "Hello all. First simple task: Message me and your group [via the MOBIlearn system[6]], in what context you currently are and what you do in general over there. Reply fast to get points". This message was sent through the MOBIlearn system and none became aware of it. So after some time a group SMS was sent to all participants to call attention to the task, but without information about the task. If all participants would have sat in front of a desktop PC at that time, it would have been a matter of a few minutes to solve the task for all. But instead, many were at lunch, at home with a flue or simply away from office. Those without internet connection first needed to find out from team members what the task actually was. Then some agreed to send their information via SMS to their team colleagues, who would post the information into the MOBIlearn system. SMS answers were not accepted. It took 10 of 12 participants about 1.5 hours after the notifying SMS and 40 internal messages to solve this task. One participant became aware of the task one day later (team 3) and one failed completely to reply (team 4).

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[6] This was a hidden restriction to be found out by the teams.

To the surprise of all participants the second task was started on a Saturday morning (8 a.m. in Spain and UK, 10 a.m. in Finland and Greece). The basic task was as simple as doing a PowerPoint portrait of the group. There were a number of restrictions like there should be a picture of each team member with the today's newspaper and sky must be seen. As another pitfall the task was described in a PowerPoint file sent through the MOBIlearn system. Only one randomly chosen person from each team got the file and needed to alarm the others. Again, if all participants would have been scheduled the time and were sitting in front of a desktop PC, it would have been a matter of at best one hour to fulfil the task. Most time would have been spent to organise a digital camera (attached to many mobile phones) for the demanded picture and buy a current newspaper. There was a high probability that both would be available without much extra effort. In fact it took the fastest group the whole Saturday and the slowest group until Monday 12 a.m. (deadline) to finish the task. Each and every collaborative step and activity turned out to become complex and a challenge under mobile conditions. The author monitored altogether incredible 107 SMSs (71 SMSs by the winning team) and 88 messages (forum, agenda, chat, messaging) through the MOBIlearn system. Furthermore one team used phone conferences and there were of course normal phone calls and mails as well. The participants reported that the task had interfered strongly with their privacy as they had been together with friends, family, or had had other obligations. Of course the ad-hoc-task did not have a high priority but was solved as side activity, being interwoven in every day's life. Even as the participants complained moderately about this interference, they found it as well very exciting and amazing how it was possible to work collaboratively in such a manner. The most active teams stayed in close touch all the time during the task and enjoyed it. As in the first task, the fastest and best solutions came from the teams 1 and 2 which were familiar with each other. Team 3 presented an equally good and team 4 an acceptable solution on Monday morning. This second task was rated best by all participants. We think it was the one with the most adequate and motivating level of complexity under the given circumstances.

Before the third task was given, some teams started frequent communication about how to be better prepared. One team agreed on a cycle for checking the MOBIlearn system frequently for the new task in case there was no SMS trigger this time. This sign of being over-motivated was taken by the author to intervene and promise, there would be an SMS trigger. Anyway, this incident showed the amazingly deep level of commitment, intensity and identification ad-hoc-tasks can create. The group-building function of the ad-hoc-task was highly assented by the participants.

The third task was by far more complex than the first ones, but the teams were trained now and thus able to deal with more complexity. Because of the complexity, the author could not moderate all teams in parallel any more, so each team got a different task at a different time, which contained a number of common elements. Each team member had to phone the experimenter individually to get a personal piece of oral information. Only the composition of all information pieces resulted in a complete picture of the ad-hoc-task. All teams were supposed to do a brainstorming and agree on the best idea by a formal voting. They all needed to produce some collaboratively written text, a presentation and additionally some short (from 30 seconds to 3 minutes) multimedia output as audio records or photomontages. Each team had once the opportunity to agree on a rejection of the start of the ad-hoc-task and receive it at another (again unspecified) time instead. Each team had four hours time to solve the task. After three hours the teams were informed they optionally got 2 additional hours, but points would

be subtracted for it. Even though most participants started complaining about the heavy workload of the experiment and other urgent pending obligations, all teams took the additional two hours. They did not realize or ignored the fact that the heavy reduction of team-performance-points for the additional time would never be compensated by the rising quality of their work. This can be seen as another indication for the high motivation created by an ad-hoc-task. After the experiences from the first two tasks, it was obvious from begin on, that the third task would mean a heavy workload. The experimenter actually expected the teams to mutiny or at least relax and decide for an acceptable minimum effort to solve the task fragmentary. Only team 4 did not even try to solve the task, because they saw no chance at all to finish it. At the end the output from the three remaining teams were fascinating considering the difficult circumstances of dealing with the task while working on other issues.

Again in this experiment we asked the participants to fill a diary with all their activities, as already been done in the first experiment. Furthermore the participants of the MOBIlearn experiment were kindly asked to answer a questionnaire of 91 rating questions with a Likert scale from 0 to 4 and 24 open questions. For those rating questions with relevance for useful skills and motivation, the average and variance have been calculated and interpreted. The comments from the open questions have as well been checked systematically for relevance. The most significant comments have been chosen to be presented in this paper as statements. Furthermore all system activities had been logged for further investigation. The performance of the teams has been rated by the experimenter, who deduced it from the quality of the final material, which was handed in by the teams as output of the tasks.

4 Results

4.1 Research Question 1: Skills for Ad-Hoc-Collaboration

In this chapter we will analyse to what degree the proposed skills suggested in 2.2 are useful to perform ad-hoc-tasks successfully.

Process facilitation skills: A major challenge for ad-hoc-collaboration lies in the spontaneous and situational arrangement and coordination of the process. In contrast to professionally trained teams for certain types of ad-hoc-tasks as firemen, medics, soldiers etc, in our case there are no established 'prior socialisations' [Pinelle 2004]. Even if roles like facilitator, time manager, caretaker for material etc. might be distributed among the team members, they cannot be fixed due to their non-permanent availability. Team members need dynamically switch roles and take over from others, so work can go on. One participant of the MOBIlearn experiment stated: "Balance of task to time is very important in a mobile situation (would apply to any distance situation) especially where the people involved are not allocated 100% of time to the activity." The central role of the facilitator must likely be distributed among team members [Bostrom 1991, Bostrom 1993], which is especially critical. Thus process facilitation skills must be available among all team members. Each team member needs furthermore to feel responsible for the process. Each must get an emphatic feeling of who is currently facilitating, when it is time to take over control and when to subordinate. A participant noted: "Time flew by - especially when waiting for contribution from others in group. Needed a group leader to take control in these cases to move things on. We fell down here - we were being too democratic".

Communication skills: Communication in mobile settings is another challenge. There are various channels available to communicate. Due to situational restrictions a compromise has to be found between the efficient and the available channel. SMS for instance was a highly available but not very rich channel. Lacking sufficient tools and structure, the communication means were used for a number of functions such as socialisation, coordination, collaboration, giving mutual awareness, and facilitation. The mix of various channels not being clearly related to functions caused a lot of confusion. One participant said: "Having several channels to communicate was more awkward than expected." It turned out that it is useful and necessary to separate or highlight at least the facilitating communication from other communication.

Awareness skills: Awareness about who is where, and does what until when, was experienced as being extremely important for the orientation of all participants. Due to lacking awareness the group members were very likely to lose orientation, act uncoordinated, fall into stress and chaos. Therefore the teams needed to spend much energy in providing awareness to each other. Awareness was seen as very important (average of 3.5 on a scale from 0 to 4) and awareness services of any kind were heavily demanded. One participant stated: "I would have needed some kind of context awareness about the members of my group, concerning the exact status of the other users (what activity, where exactly in the system, for how long etc). " Another one mentioned: "I could have done with some form of availability service - possibly associated with whether a mobile phone is on or off. To perform the trial I was not that interested in where the team members were - just what their current capabilities were."

Social skills: To our observation a crucial factor of successful ad-hoc-collaboration is the social dimension, i.e. how well the team members knew each other before. In the MOBIlearn trial the acquainted teams performed much better and were by far more motivated than the non-acquainted teams (see 4.2). A member from one of the acquainted teams stated: "We were all committed to what we had to do to succeed and willing to cooperate regardless of the time we may have needed to spend on each task." Other statements were similar. In contrary a member from the non-acquainted team 4 stated: "No member of our group had sufficient time, we did not know each other before the tasks began, and we did not have the time to get to know each other during the trial. In other words, we were not really a group." Obviously, a lack of familiarisation cannot be healed before or during the task. All teams were given sufficient time to get to know each other via distance-media, but neither team 4 nor any other team took this chance. The number of tested teams is yet too small to prove the statements above empirically, so further research should focus this issue.

Planning skills: The main attribute of an ad-hoc-task is that it cannot be pre-planned in detail. One planning issue was the challenges of collective time management. The common and 'natural' approach observed in the experiments was just to start, keep running and deliver what is finished by the deadline by increasing the stress level the closer the deadline comes. No communication of any explicit time management was detected in the log files. In fact all participants underestimated by far the time that would be needed to solve the tasks. One participant formulated this insight as such: "Mobile collaboration needs much more time than classical office communication by phone and mail". Anyway the teams reflected that they could have prepared better and would certainly do in case of repeating the experiment. They would generally have a "clear choice of tools" and agreement on the way to use those tools, e.g. make spontaneously a shared agenda. One participant noted: "More time on the organising and planning in advance. Agreeing procedures and creating templates for agenda

items etc. But I think we might spend less time overall as we know now some of the pitfalls." Thus some form of 'prior socialisation' [Pinelle 2004] seems to be feasible for ad-hoc-tasks. Participants stated that they had not been able to solve the complex third task, without having done the two simpler tasks in advance. So teams are obviously getting routine in planning their process and planning skills can be trained. One participant put it as: "Really it was practice. Also in our group we really did not know how to use the different features best. But we have learnt more since we started the trials. Doing for real makes the difference."

At least two additional skills were found important analysing the experiments' data. Competency in using mobile media: This is not yet naturally given to everyone. Participants faced a lot of problems like how to send mail via mobile phone, how to transfer a picture taken with the mobile phone's camera or how to attach a PDA via Bluetooth to the mobile phone. Unfortunately, a lot of mobile technology still needs expert knowledge to be used and is often not at all intuitive.

Multi-tasking skills: In ad-hoc-experiments the participants need to embed the suddenly appearing and unplanned task in their intended routine of the day and coordinate it quickly with other obligations. Almost all participants made explicit comments about the high stress level during the task arising from the time restriction of the ad-hoc-task itself competing with simultaneous obligations, but even more from the need to restructure all intended activities. Several participants reported stress, especially because of social duties as the following two anecdotes demonstrate: "Just realized that there was a meeting with two friends for today and the meeting time should be scheduled to be in line with the task. One friend is just coming from abroad only for the weekend." and "I was multitasking the rest of the evening. I was sitting in front of the pc and talking with my friends, who really were nice the first hours, they said that they do understand this special task. My friends had a good time together. Sometimes after 10 pm, some of my friends said that they like to go home because the host has something else to do. Some friends stayed until I finish the task and then we had a glass of wine and some peaceful talking." Another one formulated it more generally with: "I had not expected the level of intrusion into my normal activities."

4.2 Research Question 2: Motivational Power of Ad-Hoc-Tasks

The most surprising and obvious impact of ad-hoc-tasks is the motivational power. Already explaining and announcing the idea of an ad-hoc-task fascinated our participants. Even already being under heavy workload, they agreed voluntarily to participate, simply because it sounded fun and meaningful. There is not much explicit data about the motivational power derived from the first experiment, because we were not aware of this impact. We were completely overwhelmed by the activism and commitment of the students who worked on the task simultaneously to their lectures or even skipped lectures and private arrangements (entries from diverse diaries). The task was actually designed to be too complex to be solved in the given time. We wanted to make sure that not only one of the team would just do all the work. We actually expected the teams to agree on limiting their effort by solving the main parts of the task in just an acceptable and non-embarrassing way. We were wrong. The students took the task with its time restriction as challenge, accepted an extremely stressful time and delivered impressing results. In the open fields of the questionnaire most of the students stated explicitly that they had much fun and found the experiment very exciting.

Given this experience we gave the issue of motivation explicit attention in our second experiment. There we found exactly the same phenomenon of very motivated and partly even over-motivated participants once they started working on the tasks. Some seniors of the participants saw a need to intervene and ordered them to spend less time and energy in the ad-hoc-task. Even the participants themselves were surprised about "the enthusiasm of some people" and "the very very high team motivation". This observation is even more astonishing as there were a number of fun killing conditions as slow and buggy software, very heavy workload, parallel note taking for evaluation, intruding leisure time and private sphere.

In a questionnaire, we asked the participants "How much fun was it for you to participate?" On a Lickert scale from 0 to 4 the average was 2.8, which seems moderate, but actually is amazing considering the contrarious conditions. Data gives clear evidence that team 1 and 2 (acquainted teams) were by far more motivated than team 3 (less acquainted) and 4 (not acquainted). The participants of team 1 and 2 rated the question of how much fun they had in average with 3.3. We suppose, the degree of acquaintance before the ad-hoc-task is critical for the performance (both teams were considered as winners) and the motivation. The questionnaire contained further questions about how much various factors contributed to fun. The highest rating got the answer "Working with your group members" (3.4[7]/3.6[8]), followed by "The tasks themselves" (3.0/3.1) and "Experiencing the nature of a typical ad-hoc-task" (2.8/3.3). The participants liked the game-like design of the task (2.5/3.0), but did not grade it as joyful as the factors mentioned before. The "competition with the other teams" as factor of fun was even rated lower (2.3/2.9), which does not perfectly reflect the observation of the communication among team members. Especially among the teams 1 and 2 the will to win the competition was mentioned several times. The least contribution to motivation was given by the usage of mobile technology (2.2/2.9). In the last question there was a high variance of people, who liked very much dealing with mobile technology and others, who did not enjoy it at all. One participant confirmed explicitly the suggestion of [Sarker&Wells 2003] that the higher level of freedom was motivating. He stated about other factors that had increased fun: "The possibility to work freely depending on how much time I could spend on the task."

Another part of the questionnaire was about motivation[9]. We asked, "How motivated were you initially to participate?" which was rated quite high (3.0/3.3). Next we asked how much various factors contributed to motivation. The two highest ratings dealt with the group dynamics in the ad-hoc-task. Highest (3.4/3.4) was "the social pressure, not to let the group down". Second highest (2.9/3.7) was "the level of motivation of your group members". At first view both ratings are not astonishing, because we know about the motivational power of teamwork. But those teams were spread among countries and were supposed to have little awareness of each other. Normally they would not be able to infect each other with motivation. In the ad-hoc-task with mobile support, they obviously did and even to a very high degree. Especially within team 1 and 2 there was a very frequent exchange and a good awareness of the others' situation. The

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[7] First value in brackets reflects the average rating for all participants

[8] Second value in brackets reflects the average of teams 1 and 2 only, because they are even more significant than the average of all teams.

[9] The participants were not given a clear distinction between fun and motivation, so the answers may as well not be distinct.

importance of mutual awareness was affirmed by all participants (3.2/3.4) with a very low variance (0.7). Other factors for motivation were rated lower as there were "Contributing to make the success of MOBIlearn visible" (2.7/3.3), "The competition" (2.2/2.9), "Excitement about the tasks" (2.0/2.4), "The phones as prize for the winners" (0.8/1.1), and "Extrinsic motivation (e.g. order from your boss)" (0.6/0.4).

5 Lessons Learned

As conclusion we suggest to see ad-hoc-tasks in first place as an extremely motivating setting to evaluate (assessment) and train (education) a vast variety of methodical and social skills. Observing the trends towards more team work, higher mobility, convergence of work and leisure time and higher flexibility [Webster 1992], we assume that in future there will be a rising need for technological solutions and personal skills to deal with ad-hoc-tasks efficiently. Ad-hoc-tasks interfere heavily with every day's routine and thus cause a high stress level. Simple ad-hoc-tasks can today be scraped through by small, distributed, and acquainted teams which are provided with some minimum mobile technology. More complex tasks need more potent tools, devices, and networks. Anyway, naive estimation of effort needed is usually highly mistaken. The lack of natural intuition for distributed, mobile tasks paired with a lack of any coordinated process rises the complexity of an ad-hoc-task by factors. But teams can improve their general ad-hoc-task-performance by training them. With training, acquainted teams start to establish prior socialisation and thus reduce complexity. The prior level of familiarity between team members is crucial for the team's performance in solving ad-hoc-tasks and getting trained. We do not know yet about the critical factors for large groups solving ad-hoc-tasks.

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